CLAIMS

1. Device for on-line monitoring of flow quantities in a system (1) comprising a flow-creating device (12) such as a pump or a fan, comprising:

means (42; 50, 51, 52; 57) for obtaining a measure of a torque (T) of said flow-creating device (12);

means (43; 50, 51, 57) for obtaining a measure of a rotational speed (n) of said flow-creating device (12); and

means (48) for determining a value of a flow rate (Q) through said flow-creating device (12),

characterised by:

means (44) for calculating a value of a mechanical input power (P_m) of said flow-creating device (12), connected to said means (42; 50, 51, 52; 57) for obtaining a measure of a torque (T) and said means (43; 50, 51, 57) for obtaining a measure of a rotational speed;

storage means (46) for storage of data (47) representing a predetermined relation between mechanical input power (P_m) and flow rate (Q) through said flow-creating device (12); and

whereby said means (48) for determining a value of a flow rate (Q) is connected to said means (44) for calculating a value of a mechanical input power (P_m) and to said storage means (46);

said means for obtaining a measure of a rotational speed (n) in turn comprising:

at least one current sensor (51) for measuring an input current (I) of an electric motor (20), said electric motor (20) giving said torque (T) to said flow-creating device (12);

at least one voltage sensor (50) for measuring an input voltage (U) over said electric motor (20); and

means (57) for determining a value of said rotational speed (n), connected to said current sensor (51), said voltage sensor (50) and said storage means (46);

said storage means (46) being further arranged for storage of data (58) representing a predetermined relation between input current (I)

and input voltage (U) of said electric motor (20) and rotational speed (n) of said electric motor (20).

2. Device according to claim 1, **characterised in that** said means for obtaining a measure of a torque (T) in turn comprises:

at least one current sensor (51) for measuring an input current (I) of said electric motor (20);

at least one voltage sensor (50) for measuring an input voltage (U) over said electric motor (20); and

means (52; 57) for determining a value of said torque (T), connected to said current sensor (51), said voltage sensor (50) and said storage means (46);

said storage means (46) being further arranged for storage of data (54) representing a predetermined relation between input current (I) and input voltage (U) of said electric motor (20) and output torque (T) of said electric motor (20).

3. Device according to claim 1 or 2, **characterised by**:

means for determining a value of a flow-creating device efficiency (η_P), connected to said means (48) for determining a value of said flow rate (Q) and said storage means(46);

said storage means (46) being further arranged for storage of data (56) representing a predetermined relation between flow rate (Q) and flow-creating device efficiency (η_P) for said flow-creating device (12).

4. Device according to claim 3, **characterised by** means for determining a value of an electric motor efficiency (η_E), connected to said current sensor (51), said voltage sensor (50) and said means (44) for calculating a value of a mechanical input power (P_m).

5. Device according to claim 4, **characterised by** means for determining a value of a total efficiency (η_T), connected to said means (48) for

determining a value of a flow-creating device efficiency (η_P) and said means for determining a value of an electric motor efficiency (η_E).

6. Device according to any of the claims 1 to 5, **characterised by** a diagnosing means (60), connected to said determining (48) or calculating (44) means, for evaluation of time dependencies of mechanical input power (P_m), flow (Q) or efficiency (η_P, η_E, η_T) quantities.

7. Device according to claim 6, **characterised in that** said diagnosing means (60) comprises a processor and is connected to said storage means (46), said storage means (46) being arranged for storing data representing said time dependencies.

8. Device according to claim 7, **characterised in that** said storage means (46) is arranged for storing data representing comparison curves of earlier registered time dependencies.

9. Device according to any of the claims 1 to 8, **characterised by** a monitor (32), connected to said determining means (48), for monitoring flow (Q) or efficiency (η_P, η_E, η_T) quantities.

10. Soft starter device comprising a device for monitoring flow quantities according to any of the claims 1 to 9.

11. Frequency inverter device comprising a device for monitoring flow quantities according to any of the claims 1 to 9.

12. Flow system (1), having a flow-creating device (12) such as a pump or a fan arranged for moving a fluid, and means for on-line monitoring of flow quantities, said means for monitoring flow quantities in turn comprising:

means (42; 50, 51, 52; 57) for obtaining a measure of a torque (T) of said flow-creating device (12);

means (43; 50, 51, 57) for obtaining a measure of a rotational speed (n) of said flow-creating device (12); and

means (48) for determining a value of a flow rate (Q) through said flow-creating device (12),

characterised in that said means for monitoring flow quantities further comprises:

means (44) for calculating a value of a mechanical input power (P_m) of said flow-creating device (12), connected to said means (42; 50, 51, 52; 57) for obtaining a measure of a torque (T) and said means (43; 50, 51, 57) for obtaining a measure of a rotational speed;

storage means (46) for storage of data (47) representing a predetermined relation between mechanical input power (P_m) and flow rate (Q) through said flow-creating device (12); and

whereby said means (48) for determining a value of a flow rate (Q) is connected to said means (44) for calculating a value of a mechanical input power (P_m) and to said storage means (46) ;

said means for obtaining a measure of a rotational speed (n) in turn comprising:

at least one current sensor (51) for measuring an input current (I) of an electric motor (20), said electric motor (20) giving said torque (T) to said flow-creating device (12);

at least one voltage sensor (50) for measuring an input voltage (U) over said electric motor (20); and

means (57) for determining a value of said rotational speed (n), connected to said current sensor (51), said voltage sensor (50) and said storage means (46);

said storage means (46) being further arranged for storage of data (58) representing a predetermined relation between input current (I) and input voltage (U) of said electric motor (20) and rotational speed (n) of said electric motor (20).

13. Flow system according to claim 12, **characterised in that** said means for obtaining a measure of a torque (T) in turn comprises:

at least one current sensor (51) for measuring an input current (I) of said electric motor (20);

at least one voltage sensor (50) for measuring an input voltage (U) over said electric motor (20); and

means (52; 57) for determining a value of said torque (T), connected to said current sensor (51), said voltage sensor (50) and said storage means (46);

said storage means (46) being further arranged for storage of data (54) representing a predetermined relation between input current (I), input voltage (U) of said electric motor (20) and output torque (T) of said electric motor (20).

14. Flow system according to claim 12 or 13, **characterised in that** said means for monitoring flow quantities further comprises:

means (48) for determining a value of a flow-creating device efficiency (η_P), connected to said means (48) for determining a value of said flow rate (Q) and said storage means(46);

said storage means (46) being further arranged for storage of data (56) representing a predetermined relation between flow rate (Q) and flow-creating device efficiency (η_P) for said flow-creating device (12).

15. Flow system according to any of the claims 12 to 14, **characterised by** a diagnosing means (60), connected to said determining (48) or calculating (44) means, for evaluation of time dependencies of mechanical input power (P_m), flow (Q) or efficiency (η_P, η_E, η_T) quantities.

16. Flow system according to any of the claims 12 to 15, **characterised by** a monitor (32), connected to said determining means (48), for monitoring flow (Q) or efficiency (η_P, η_E, η_T) quantities.

17. Flow system according to claim 16, **characterised in that** said monitor (32) is positioned remotely in relation to said flow-creating device (12).

18. Device for on-line diagnostics of performance in a system (1) comprising a flow-creating device (12) such as a pump or a fan, comprising:

means (42; 50, 51, 52; 57) for obtaining a measure of a torque (T) of said flow-creating device (12);

means (43; 50, 51, 57) for obtaining a measure of a rotational speed (n) of said flow-creating device (12); and

storage means (46),

characterised by:

means (44) for calculating a value of a mechanical input power (P_m) of said flow-creating device (12), connected to said means (42; 50, 51, 52; 57) for obtaining a measure of a torque (T) and said means (43; 50, 51, 57) for obtaining a measure of a rotational speed;

diagnosing means (60), connected to said calculating means (44), for evaluation of time dependencies of mechanical input power (P_m) ;

said means for obtaining a measure of a rotational speed (n) in turn comprising:

at least one current sensor (51) for measuring an input current (I) of an electric motor (20); said electric motor (20) giving said torque (T) to said flow-creating device (12);

at least one voltage sensor (50) for measuring an input voltage (U) over said electric motor (20); and

means (57) for determining a value of said rotational speed (n), connected to said current sensor (51), said voltage sensor (50) and said storage means (46);

said storage means (46) being arranged for storage of data (58) representing a predetermined relation between input current (I) and input voltage (U) of said electric motor (20) and rotational speed (n) of said electric motor (20).

19. Device according to claim 18, **characterised in that** said storage means (46) is arranged for storing data representing said time dependencies.

20. Device according to claim 19, **characterised in that** said storage means (46) comprises data is arranged for storing data representing comparison curves of earlier registered time dependencies.

21. Method of on-line monitoring flow quantities in a system (1) comprising a flow-creating device (12) such as a pump or a fan, comprising the steps of:

obtaining a measure of a torque (T) of said flow-creating device (12);

obtaining a measure of a rotational speed (n) of said flow-creating device (12), and

determining a value of a flow rate (Q) through said flow-creating device (12), based on said measure of a torque (T) and said measure of a rotational speed (n),

characterised by the further step of:

calculating a value of a mechanical input power (P_m) of said flow-creating device (12) based on said measure of a torque (T) and said measure of a rotational speed (n);

said determining step using said mechanical input power (P_m) and a predetermined relation between mechanical input power (P_m) and flow rate (Q) through said flow-creating device (12);

said step of obtaining a measure of a rotational speed (n) in turn comprising the steps of:

measuring an input current (I) of an electric motor (20), said electric motor (20) giving said rotational speed (n) to said flow-creating device (12);

measuring an input voltage (U) over said electric motor (20); and

determining a value of said rotational speed (n), using said input current (I) and input voltage (U) and a predetermined relation between input current (I), input voltage (U) and rotational speed (n) of said electric motor (20).

22. Method according to claim 21, **characterised by** the further step of:

controlling parameters of said system (1) based on said flow rate (Q).

23. Method according to claim 21 or 22, **characterised by** the further step of:

empirically determining said predetermined relation between mechanical input power (P_m) and flow rate (Q) through said flow-creating device (12) prior to installation of said flow-creating device (12).

24. Method according to claim 21, 22 or 23, **characterised in that** said step of obtaining a measure of a torque (T) in turn comprises the steps of:

measuring an input current (I) of said electric motor (20);

measuring an input voltage (U) over said electric motor (20); and

determining a value of said torque (T), using said input current (I) and input voltage (U) and a predetermined relation between input current (I), input voltage (U) and torque (T) of said electric motor (20).

25. Method according to claim 24, **characterised by** the further step of:

empirically determining said predetermined relation between input current (I), input voltage (U) and torque (T) of said electric motor (20) prior to installation of said flow-creating device (12).

26. Method according to any of the claims 21 to 25, **characterised by** the further step of:

empirically determining said predetermined relation between input current (I), input voltage (U) and rotational speed (n) of said electric motor (20) prior to installation of said flow-creating device (12).

27. Method according to any of the claims 21 to 26, **characterised by** the further step of:

determining a value of a flow-creating device efficiency (η_P), using said value of said flow rate (Q) through said flow-creating device (12) and a predetermined relation between flow rate (Q) and flow-creating device efficiency (η_P) for said flow-creating device (12).

28. Method according to any of the claims 21 to 27, **characterised by** the further step of:

registering of time dependencies of said mechanical input power (P_m), flow (Q) or efficiency (η_P, η_E, η_T) quantities;

evaluating said time dependencies for diagnosing of the operation of said flow-creating device (12).

29. Method according to claim 28, **characterised in that** said step of registering comprises storing of said time dependencies in a storage means (46).

30. Method according to claim 29, **characterised in that** said step of evaluation comprises comparing said time dependencies with earlier registered time dependencies.

31. Method according to any of the claims 27 to 30, **characterised by** the further step of:

determining a value of an electric motor efficiency (η_E), using said value of said mechanical input power (P_m), said input current (I) and said input voltage (U).

32. Method according to claim 31, **characterised by** the further step of:

determining a value of a total efficiency (η_T), multiplying said flow-creating device efficiency (η_P) and said electric motor efficiency (η_E).

33. Method of on-line diagnosing of performance of a system comprising a flow-creating device (12) such as a pump or a fan, comprising the steps of:

obtaining a measure of a torque (T) of said flow-creating device (12); and

obtaining a measure of a rotational speed (n) of said flow-creating device (12),

characterised by the further steps of:

calculating a value of a mechanical input power (P_m) of said flow-creating device (12) based on said measure of a torque (T) and said measure of a rotational speed (n);

registering of time dependencies of said mechanical input power (P_m); and

evaluating said time dependencies for diagnosing of the operation of said flow-creating device (12);

said step of obtaining a measure of a rotational speed (n) in turn comprising the steps of:

measuring an input current (I) of an electric motor (20), said electric motor (20) giving said rotational speed (n) to said flow-creating device (12);

measuring an input voltage (U) over said electric motor (20); and

determining a value of said rotational speed (n), using said input current (I) and input voltage (U) and a predetermined relation between input current (I), input voltage (U) and rotational speed (n) of said electric motor (20).

34. Method according to claim 33, **characterised in that** said step of registering comprises storing of said time dependencies in a storage means (46).

35. Method according to claim 34, **characterised in that** said step of evaluation comprises comparing said time dependencies with earlier registered time dependencies.

36. A computer program product comprising computer code means and/or software code portions for making a processor perform the steps of any of the claims 21 to 35.

37. A computer program product according to claim 36 supplied via a network, such as Internet.

38. A computer readable medium containing a computer program product according to claim 36 or 37.

39. A data storage means arranged in a softstarter or frequency converter of an electric motor (20) driving a flow-creating device (12) such as a pump or fan, comprising stored data (47) representing a predetermined relation between mechanical input power (P_m) of said flow-creating device (12) and flow rate (Q) through said flow-creating device (12).

40. A data storage means according to claim 39, **characterised by** further comprising stored data (58) representing a predetermined relation between input current (I) and input voltage (U) of said electrical motor (20) and output torque (T) of said electrical motor (20).
